

**Susitna-Watana Hydroelectric Project
(FERC No. 14241)**

**Baseline Water Quality Study
Study Plan Section 5.5**

**Initial Study Report
Part C: Executive Summary and Section 7**

Prepared for

Alaska Energy Authority



SUSITNA-WATANA HYDRO

Clean, reliable energy for the next 100 years.

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EXECUTIVE SUMMARY

Baseline Water Quality Study Section 5.5	
<p>Purpose</p>	<p>The Baseline Water Quality Study (Study 5.5) is generating water quality information for several purposes and as follows:</p> <ul style="list-style-type: none"> • Document historical water quality data and combine with data generated from this study. The combined dataset will be used in the Water Quality Modeling Study (Study 5.6) to predict Project impacts under alternative Project operations. • Add three years of current stream temperature and meteorological data to the existing data. • Develop a monitoring program to adequately characterize surface water physical, chemical, and bacterial conditions in the Susitna River within and downstream of the proposed Project area. • Measure baseline metals concentrations in sediment and fish tissue for comparison to state criteria and Screening Quick Reference tables. • Perform a pilot thermal infrared remote (TIR) sensing effort of the Susitna River from Susitna Station (PRM 29.9) to Oshetna River (PRM 235.6), and use this data to map the groundwater discharge and possible extent of thermal refugia. <p>This information will be used to evaluate current and future water quality conditions by combining projected modeling results for both the reservoir and riverine portions of the basin.</p>
<p>Status</p>	<p>In this multi-year study, the 2013 data collection efforts generated the following types of water quality data: large-scale monitoring, Focus Area monitoring, continuous temperature monitoring, meteorological monitoring, sediment monitoring, fish tissue monitoring, and vegetation monitoring at sites identified in the RSP Section 5.5. AEA expects to complete the data collection during the 2014 and 2015 study seasons.</p>
<p>Study Components</p>	<p>The Baseline Water Quality Study has several components that generate water quality data from multiple media and will be used to evaluate current and Post-Project conditions when the reservoir is in place. The study components include: 1) water quality monitoring at two spatial scales, 2) Focus Area monitoring for the purpose of improving the resolution of water quality predictions and in support of the fisheries and habitat evaluation, and 3) mercury assessment for the purpose of determining how future reservoir operations might influence dynamics of mercury release and bioaccumulation in aquatic life. Products generated from the Baseline Water Quality Study are used in the Water Quality Modeling Study (Study 5.6), Mercury Assessment and Potential for Bioaccumulation Study (Study 5.7), Ice Processes Study (Study 7.6), Glacier Runoff and Changes Study (Study 7.7), and the Fish and Aquatics Instream Flow Study (Study 8.5).</p>

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2013 Variances	<ul style="list-style-type: none"> • Establishment of water temperature monitoring sensors was planned for 37 sites in 2013. Equipment deployment for temperature monitoring was completed at 28 sites on the Susitna River mainstem and tributaries (RSP Section 5.5.4.1). • Sampling from Baseline Water quality sites resulted in minor adjustments of location at 3 of the 17 sites proposed in the RSP (RSP Section 5.5.4.4). A location was added at PRM 174.0 to characterize water quality conditions below the dam site. • Ten Focus Areas were described in RSP Section 5.5 for water quality sampling during 2013. Seven Focus Areas of the ten candidate Focus Areas were monitored in 2013 (RSP Section 5.5.4.5). While land access was not available for portions of the river and tributaries adjacent to Cook Inlet Regional Working Group (CIRWG) in 2013, this was not considered a variance because this study was designed to collect data over multiple years. • Visits to ten sites for collection of sediment samples were proposed in the RSP Section 5.5.4.6. Six sites were not visited in 2013 (Susitna Above Watana Dam, Susitna Below Watana Dam, Fog Creek, Deadman Creek, Watana Creek, and Tsusena Creek) due to lack of access to CIRWG lands. • Groundwater sampling piezometer wells were originally described for placement at the end of each mainstem transect within each Focus Area. However, the wells had to be relocated to areas where they could be successfully installed and were also more applicable in support of the Instream Flow Study (Section 8.5 of the ISR).
Steps to Complete the Study	<p>AEA’s plans for completing this study are included in ISR Study 5.5 Section 7.2. A summary of remaining Study 5.5 activities is as follows:</p> <p>Planned 2014 Activities</p> <ul style="list-style-type: none"> • Water Temperature Data Collection <ul style="list-style-type: none"> ▪ Continuous temperature loggers will be deployed at 38 sites ▪ Loggers will be installed by the end of June 2014, with monthly downloads of all sites to follow ▪ Logging interval will be changed for all loggers in September 2014 from 15 minutes to 30 minutes due to data storage limitations over winter months, allowing for temperature data collection from September 2014 through June 2015. • Meteorological Data Collection <ul style="list-style-type: none"> ▪ MET Stations EMS-1, EMS-2, and EMS-3 will continue to be maintained through the 2014 field season. ▪ Meteorological data will continue to be downloaded from the three MET stations established between PRM 142.2 to PRM 235.2, as

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well from the 3 existing MET stations located between Willow Creek and the Talkeetna Airport.

- Baseline Water Quality Monitoring
 - Baseline water quality monitoring samples will be collected at 17 sites from PRM 29.9 to PRM 235.2 each month from June 2014 through September 2014
 - In-situ field measurements will be collected at each location using a Hydrolab® datasonde (MS5).
 - A single grab sample will be collected monthly at each location and be analyzed for all total metals (except Ca & Mg) and dissolved Al, TP, TKN, & nitrate+nitrite-nitrogen.

- Focus Area Water Quality
 - Focus Areas (in coordination with Study Plan 8.5, Instream Flow) will be sampled in 2014 to obtain results for water quality parameters that did not meet data quality objectives (Section A.7.1. of the QAPP) in 2013.
 - In-situ field measurements will be collected with a Hydrolab® datasonde (MS5) at each point sample location, at the center of each transect within the main channel, and at locations along the transects in selected side channels where the flow differs from the main channel.
 - A single grab sample will be collected once in July and once in August at each point sample location, at the center of each transect, and at locations along the transects in selected side channels where the flow differs from the main channel. The grab samples will be analyzed for all total metals (except Ca & Mg) and dissolved Al, TP, TKN, & nitrate+nitrite-nitrogen.

- Sediment and Porewater Sampling
 - Sediment and porewater samples will be collected at the 6 sampling sites that were not visited in 2013 (Susitna Above Watana Dam, Susitna Below Watana Dam, Fog, Deadman, Watana, and Tsusena) once in August or September 2014.

- Thermal Infrared Remote Sensing
 - The remaining portions of the Lower River that were not surveyed during the 2013 field season (approximately 27% of the total) due to adverse weather conditions will be flown during the 2014 field season.

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	<p>Completing the Study</p> <ul style="list-style-type: none"> • Water Temperature Data Collection <ul style="list-style-type: none"> ▪ Continuous temperature loggers deployed during the 2014 field season will remain in place through June 2015. • Meteorological Data Collection <ul style="list-style-type: none"> ▪ MET Stations ESM-1, ESM-2, and ESM-3 will continue to be maintained through June 2015. ▪ Meteorological data will continue to be downloaded from the three MET stations established between PRM 142.2 to PRM 235.2, as well from the three existing MET stations located between Willow Creek and the Talkeetna Airport.
Highlighted Results and Achievements	<p>The Baseline Water Quality Study components have generated 2 years of water temperature monitoring data, 1.5 years of meteorological monitoring data, two-thirds of the proposed large-scale and Focus Area monitoring program data, and half of the sediment monitoring data required for assessment of potential effects from mercury bioaccumulation. Water temperature monitoring data, both historical and current, are being used to calibrate the reservoir and riverine water quality models. Meteorological data generated in this study is being used to calibrate the reservoir water quality model.</p> <p>Following a preliminary quality assurance review of water quality data, elevated concentration of total phosphorus, nitrate+nitrite-nitrogen, and select metals were found. These patterns were most common to samples collected from the mainstem Susitna River where glacial flour (turbidity resulting from glacial erosion) is likely interfering with sample analysis. For select water quality parameters where split samples confirmed analytical inconsistencies, additional sampling for laboratory split analysis will be conducted in 2014.</p> <p>Available 1970s and 1980s data were evaluated for use in this Project. A subset of in situ field parameters (water temperature, specific conductance, dissolved oxygen, and pH) collected during the summer months (June through September) from 1970 through 1980 and during the 2013 field season were compared for four Project sites (PRM 29.9, PRM 107, PRM 124.2, and PRM 187.2). Maximum water temperatures collected in 2013 were comparable to measurements made at the same sites in the 1970s and 1980s. Minimum temperatures measured at these sites were lower in the historic dataset representing sample timing that began earlier during ice break-up. The expanded data record from the 1970s and 1980s can be combined with current data for calibrating the water quality model. Similarly, mean specific conductance was higher in 2013 compared to historic data, though this</p>

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comparison is limited to two sites (PRMs 29.9 and 107). Dissolved oxygen (DO) and pH were similar between datasets for three sites where comparable data are available (PRM 29.9, PRM 107.0, and PRM 124.2).

7. COMPLETING THE STUDY

7.1. Proposed Methodologies and Modifications

To complete this study, AEA will implement the methods in the Study Plan except as described in Sections 7.1.2. These activities include:

- Install and download water temperature loggers throughout the study area (RSP Section 5.5.4.1.)
- Maintain and download relevant meteorological data from identified locations (RSP Section 5.5.4.2.)
- Collect baseline water quality samples and in-situ parameters on a monthly basis (RSP Section 5.5.4.4.)
- Collect water quality samples and in-situ parameters from within Focus Areas (RSP Section 5.5.4.5.)
- Collect sediment and porewater samples from specified locations (RSP Section 5.5.4.6.)
- Complete thermal infrared survey for remaining un-surveyed portions of the lower river (RSP Sections 5.5.4.9 and 5.5.4.10)

7.1.1. Decision Points from Study Plan

There were no decision points in the FERC-approved Study Plan to be evaluated for this study following the completion of 2013 work.

7.1.2. Modifications to Study Plan

Proposed modifications to the Study Plan components are described below.

Water Temperature Data Collection

Water Temperature Data Collection Logging interval from October 2013 through June 2014 will be 30-minutes (instead of 15 minutes as stated in RSP Section 5.5.4.1) to expand data storage capacity. 2012 water temperature monitoring effort resulted in data logger operation through April 2013. Data logger capacity was limited to approximately seven months with 15-minute logging intervals. Data logging intervals will also be adjusted from 15-minute intervals to 30-minute intervals on the final download of summer monitoring (August-September 2014) depending on timing of formation of ice cover on the river.

Meteorological Data Collection

A rain gauge and CS725 snow water equivalency (SWE) sensor will be installed at MET station ESM1, if possible. This is a modification as there is no reference for installation of a snow water equivalency sensor to the MET stations in the Study Plan (RSP Section 5.5.4.2).

Baseline Water Quality Monitoring

The extent of sampling efforts for baseline water quality monitoring was refined based on review of remaining data collected during 2013 and how data quality objectives were met. Available laboratory results through September 30, 2013 like chlorophyll a and all field results are included in the 2013 ISR. Remaining laboratory results will be included in the USR following evaluation for data quality as described in the QAPP Section D.1. Data Validation and Usability.

Through validation of laboratory data it was determined that select water quality parameters were outside of acceptance limits during laboratory analysis. That is sample preservative affected detection of the target analyte by the laboratory equipment, and bottles or reagent water was contaminated with the target analyte(s). A table summarizing the results of the lab data validation/verification can be found in the GINA database at the following location:

<http://gis.suhydro.org/reports/isr/05-Water Quality/>

The parameters affected were total metals (except for Ca and Mg), total mercury, total phosphorus, total Kjeldahl nitrogen (TKN), total nitrate+nitrite-nitrogen, and dissolved aluminum. These parameter results were either qualified as “rejected” or “estimated” throughout the 2013 study and will be sampled again in 2014.

The strategy for additional sampling was based on results from comparison of 2013 results with applicable criteria or thresholds (RSP Section 5.5.4.4). Contiguous sites may be identified for more intensive sampling to identify sources and mechanisms for bioaccumulation of metals in fish (RSP Section 5.5.4.6). Current plans include continued sampling for monthly baseline water quality from June to September 2014 at the same sites sampled in 2013.

Given the lack of horizontal or vertical variability in the results for 2013 (ISR Section 5.4.1), only a single grab sample will be collected at each site transect, a change in the sampling protocols reported in the Study Plan (RSP Section 5.5.4.4.2.). The single grab sample from each location at each monthly site will be analyzed for all total metals (except Ca & Mg) and dissolved Al, TP, TKN, & nitrate+nitrite-nitrogen, a modification of RSP Section 5.5.4.4.1 including Table 5.5-4. The data for these analytes from the 2013 field season were classified as either estimated or rejected, thus requiring re-sampling during the 2014 field season to determine if a correction factor can be developed and applied to the affected 2013 data (see section 7.1.1 for lab data validation).

Split samples collected in 2013 and submitted to independent laboratories confirmed analytical inconsistencies (ISR Section 5.4.) prompting additional data collection to verify causes for failing the data validation/verification review. Accordingly, the following water quality parameters will be submitted for laboratory split sample analysis only during the month of July 2014: all total metals (except Ca & Mg) and dissolved Al, TP, TKN, and nitrate+nitrite-nitrogen. (See QAPP Section C.4 for further discussion about this quality objective).

Focus Area Water Quality Monitoring

Focus Areas will be re-sampled in 2014 to generate valid water quality data and to determine if a correction factor may be used to validate 2013 data (this effort is in coordination with Study

Plan 8.5, Instream Flow). Groundwater results from 2013 were within acceptance limits when reviewed for validity and verification against laboratory performance expectations. Groundwater wells will be resampled in 2014 during Focus Area sampling. The groundwater well sampling sites are identical to the sites visited during 2013.

Given the lack of horizontal or vertical variability in water quality results for 2013 observations along each transect for both (ISR Sections 5.4.1 and 5.4.2), changes will be made to the number of grab samples and field parameters collected during the 2014 field season from the protocols specified in RSP Section 5.5.4.5. Re-sampling during 2014 will consist of collecting a single grab sample once in July and August at each point sample location, and at a depth of 1.5m (where possible) at both the center of each transect within the main channel and at locations along the transects in selected side channels where the flow differs from the main channel. Samples will be analyzed for all total metals (except Ca & Mg) and dissolved Al, TP, TKN, and nitrate+nitrite-nitrogen; a modification of RSP Section 5.5.4.5. The data for these analytes from the 2013 field season were classified as either estimated or rejected, thus requiring re-sampling during the 2014 field season (see section D.1. in the QAPP for lab data validation).

Re-sampling of water quality data from Focus Areas during 2014 will not affect timeline for construction and calibration of the reservoir and riverine water quality models (RSP Section 5.5.4.5.). The second set of select parameters collected during 2014 will be used to determine the usability of 2013 data by developing a “correction factor” to adjust concentrations to within expected ranges (based on historic data results, when available) and eliminate bias introduced by one or more acceptance limit factors not met by results in the original data set.

Sediment and Porewater Sampling

Sediment samples and porewater samples will be collected in August or September 2014 from the six locations around the Watana Dam site that were not collected during the scheduled 2013 field effort. If the original sites are not accessible, sediment and porewater sampling locations will be moved to alternate locations that represent the same type of settings of the original, proposed sites (RSP Section 5.5.4.6.)

RSP Section 5.5.4.6 specified the use of an Ekman dredge or modified Van Veen grab sampler for sediment sampling, but due to sampling site conditions a hand auger or stainless steel spoon will be used instead. This method was also used during the 2013 study.

Thermal Infrared Remote Imaging

Due to adverse weather conditions, not all data could be collected from the lower river during the 2013 field season (RSP Section 5.5.4.9.). Acquisition of the data requires that the air temperature be cold (near freezing), with no wind, no ice on the river, and no precipitation. Despite six weeks of effort during October and November of 2013, approximately five days of usable data were recovered. These data include all the Focus Areas, and 73% of the Lower River. The remaining portions of the Lower River will be collected during the 2014 field season as weather permits.

7.2. Schedule

In general, the schedule for completing the FERC-approved Study Plan is dependent upon several factors, including Project funding levels authorized by the Alaska State Legislature, availability of required data inputs from one individual study to another, unexpected weather delays, the short duration of the summer field season in Alaska, and other events outside the reasonable control of AEA. For these reasons, the Study Plan implementation schedule is subject to change, although at this time AEA expects to complete the FERC-approved Study Plan through the filing of the Updated Study Report by February 1, 2016, in accordance with the ILP schedule issued by FERC on January 28, 2014.

With regard to this specific study, AEA expects to complete data collection in both the 2014 and 2015 study seasons, which will be reported in the USR. The extent of sampling efforts for baseline water quality monitoring was determined based on review of data collected during 2013 and how data quality objectives were met. The strategy for additional sampling was based on results from comparison of 2013 results with applicable criteria or thresholds (RSP Section 5.5.4.4). In 2015, AEA plans to complete all remaining data collection and analysis for this study. A schedule for the 2014 activities is as follows:

Water Temperature Data Collection

- With permission to access Cook Inlet Regional Working Group (CIRWG) lands, 38 temperature monitoring sites will be visited in 2014 for continuous temperature characterization. Water temperature probes lost over the winter (2013/2014) will be replaced at 2013 site locations and downloaded monthly. All site deployments prior to winter 2013/2014 will be re-visited in June 2014 for data retrieval and re-deployment of water temperature probes using 15-minute logging intervals. The same water temperature monitoring apparatus will be deployed at sites above PRM 145.6 up to PRM 196.8 (Table 4.1-1) in addition to those accessible sites. Thermistors will be re-deployed during June 2014 and data downloads will occur monthly. During August-September 2014, over-winter systems will be installed and thermistors will be adjusted to log at 30 minute intervals in order to conserve space for data to be stored through winter 2014-2015 (September 2014-June 2015).
- Continuous temperature data collection in 2014 for Baseline Water Quality Monitoring sites and single measurements made in Focus Area locations will be partitioned for use in: 1) further calibration of water temperature models, and 2) validation of water temperature models.

Meteorological Data Collection

- MET Stations ESM-1, ESM-2, and ESM-3 will continue to be maintained through the 2014 field season.
- Meteorological data will continue to be downloaded from the three MET stations established between PRM 142.2 to PRM 235.2, as well from an existing MET station located at the Talkeetna Airport.

Baseline Water Quality Monitoring

- Baseline water quality monitoring samples will be collected at 17 sites from PRM 29.9 to PRM 235.2 each month from June 2014 through September 2014.
- In-situ field measurements will be collected at each location using a Hydrolab® datasonde (MS5).
- A single grab sample will be collected at each location at each monthly site and be analyzed for all total metals (except Ca & Mg) and dissolved Al, TP, TKN, & nitrate+nitrite-nitrogen.
- For select water quality parameters where split samples confirmed analytical inconsistencies, additional sampling for laboratory split analysis will be conducted.

Focus Area Water Quality

- Focus Area reaches will be re-sampled for water quality characterization at a reduced number of locations, in coordination with the Instream Flow Study (Study 8.5), in order to regenerate data for select parameters collected during 2013 that did not meet quality assurance requirements.
- In-situ field measurements will be collected at each location using a Hydrolab® datasonde (MS5).
- A single grab sample will be collected once in July and August at each point sample location, and at a depth of 1.5m (where possible) at both the center of each transect within the main channel and at locations along the transects in selected side channels where the flow differs from the main channel, and will be analyzed for all total metals (except Ca & Mg) and dissolved Al, TP, TKN, & nitrate+nitrite-nitrogen.

Sediment and Porewater Sampling

- Sediment and porewater samples will be collected at the six remaining sampling sites that were not visited in 2013 (Susitna Above Watana Dam, Susitna Below Watana Dam, Fog, Deadman, Watana, and Tsusena) once in August or September 2014.

Thermal Infrared Remote Sensing

- The remaining portions of the Lower River that were not surveyed during the 2013 field season (approximately 27% of the total) due to adverse weather conditions will be flown during the 2014 field season as weather permits.

7.3. Conclusion

Significant progress has been made to date on meeting the objectives of the study plan as specified in Section 2 of the ISR, and a majority of the field data has been successfully collected. The remaining field work is mostly designed to broaden the base of data available for modeling (Section 5.6), provide additional data for identified data gaps, and complete minor field work that was not completed due to poor weather conditions or site access restrictions (ISR Section 4.1.4.).

Data collection will continue in 2014 as described above in Section 7.2, adding to current datasets.

Water quality sampling scheduled for the 2014 field season will provide the remaining parameters (ISR Section 7.1.2) needed to adequately characterize surface water physical, chemical, and bacterial conditions in the Susitna River within and downstream of the proposed Project. Once completed, the dataset will then be combined with historical water quality data to be used in the Water Quality Modeling Study (Study 5.6) to predict Project impacts under various operations.

Based on the modifications specified in Section 7.1.2 and the schedule described in Section 7.2, it is anticipated that the baseline water quality study will meet the study plan objectives for water quality specified in ISR Section 2 while also providing sufficient data for the interdependent studies to move forward.